Space Weather Technical Forecast

Issued on Saturday, 21 September 2024 at 01:56 Local

From the 24th of September, the way we distribute this forecast is changing and you will need to take action to continue receiving it. You should have received an email on the 4th of September explaining the steps required to do this. If you have already signed up to receive the forecast on our premium website, please disregard this message. If you haven't, or if you need help with the process, please contact moswoc@metoffice.gov.uk

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-flares and R1-R2/Minor-Moderate Radio Blackouts throughout. Active electron fluence likely from later Day 1.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with peak flare C3.9 at 20/1457 from near AR3831 near centre disc. This produced a dimming event on the disc but no CME was observed. There are currently seven sunspot regions on the disc. There are a number of areas of interest on the disc including aforementioned AR3831 which rapidly grew on 19 Sep and now contains a faint delta region in its larger lead spot. AR3828, in the southeast, is now the largest region on the disc and has exhibited continued growth and decay of spots within the region, continuing to change and evolve between analyses. This region is one of the more complex on the visible disc. AR3825, which produced the X4.5 on 14 Sep, is now a comparatively small and simple region compared to its history, but with a Beta-Gamma-Delta configuration that perhaps suggests an ongoing potential for some notable flares. AR3824 departed the disc during the past 24 hours.

No Earth-directed CMEs were observed on available imagery.

Solar Wind / Geomagnetic Activity: Solar wind speeds, as observed by ACE at L1, have fluctuated between slow ambient and Slightly Elevated (350-450 km/s) with a general declining trend through the UTC afternoon of 20 Sep. Solar wind density remained below average. The Interplanetary Magnetic Field, Bt, has been weak throughout around 7nT. The north-south component, Bz, has fluctuated weakly throughout varying between +6nT and -4nT. Phi angle remained predominantly positive (away from the Sun). Geomagnetic activity was mostly Quiet (Kp 0-2) but has increased to Unsettled (Kp 3) in the most recent interval.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 was at Background. High energy electron flux (greater than 2MeV) observed by GOES16 rose from initially Moderate with a diurnal peak at High in the period between approximately 20/1430-2000 UTC, peaking 1240 pfu at 20/1820 UTC. The associated 24-hour fluence showed a rising trend, but remained below Active, with the 21/0000UTC observation being 2.49e7 total pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with a chance of isolated M-class flares. No significant regions are expected to depart or rotate onto the disc during the period.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Slightly elevated solar winds are expected to ease to mainly background. Chance of slight enhancement due to HSS

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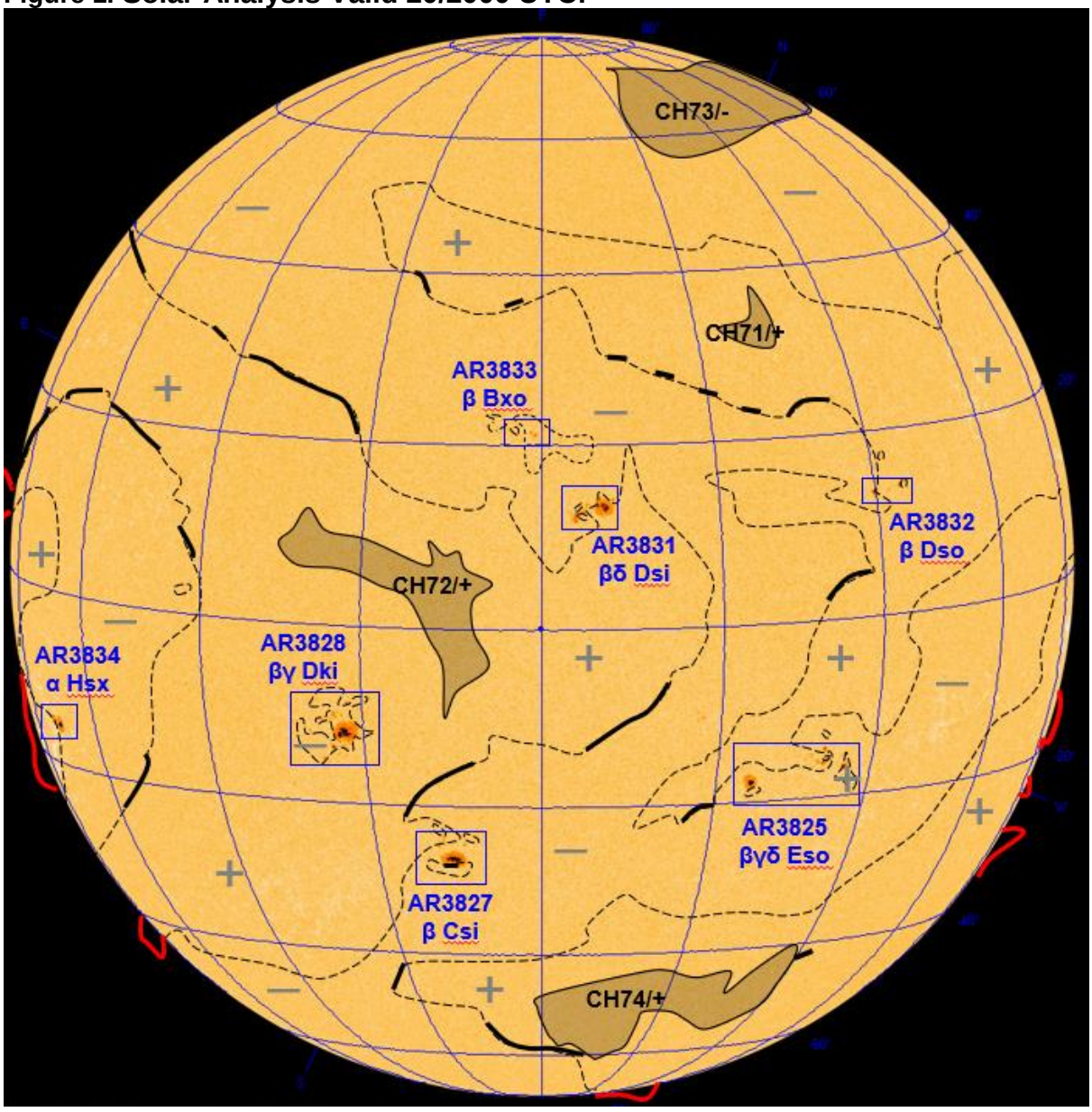
arrivals, the most likely on Day 2-3 (22-23 Sep) from any interaction with the fast wind of small CH71/+ in the northwest. Mainly Quiet to Unsettled activity (Kp 0-3) with a chance of a spells of Unsettled to Active (Kp 3-4) associated with the potential for HSS arrivals.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is expected to remain at Background. High energy electron flux is forecast to be Moderate with reaching High at diurnal maximum, perhaps persistently High from later Day 1 (21 Sep). This brings a chance of Active Fluence, mainly Days 1-2. Confidence falls later in the period due to uncertainty in the arrival and influence of coronal hole fast winds.

Figure 1. Solar Analysis Valid 20/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs currently feature in the forecast.

Slightly elevated solar winds at first are expected to ease to Background, although a number of weak enhancements are possible during the period. The first, being from small CH70/+ which was previously visible on the western hemisphere which may be responsible for the recent Unsettled interval 20/2100-2359 UTC. Weak enhancement is also possible later Day 2 or Day 3 (22-23 Sep) from the small northern coronal hole CH71/+. This is low confidence due to its small size and northern position. However, given Day 1 (21 Sep) is the September equinox, the positive polarity of the Coronal hole may be sufficient to produce an Active interval should enhancement occur. Connection to a HSS from CH72/+ in the eastern hemisphere is not expected until beyond the forecast period, but some slight enhancement is possible to wind speeds at the very end of Day 4 (24 Sep). This coronal hole is in a similar position to on the previous rotation, but appears stronger and extends slightly further west, suggesting a stronger response and greater possibility of enhancement.

Geomagnetic activity is forecast to be mainly Quiet (Kp 0-2) with isolated Unsettled (Kp 3) intervals and a chance of a spell of Unsettled to Active (Kp 3-4) initially, and again late Day 2 or Day 3. Possible enhancement to Active at the very end of Day 4.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

No CMEs expected.

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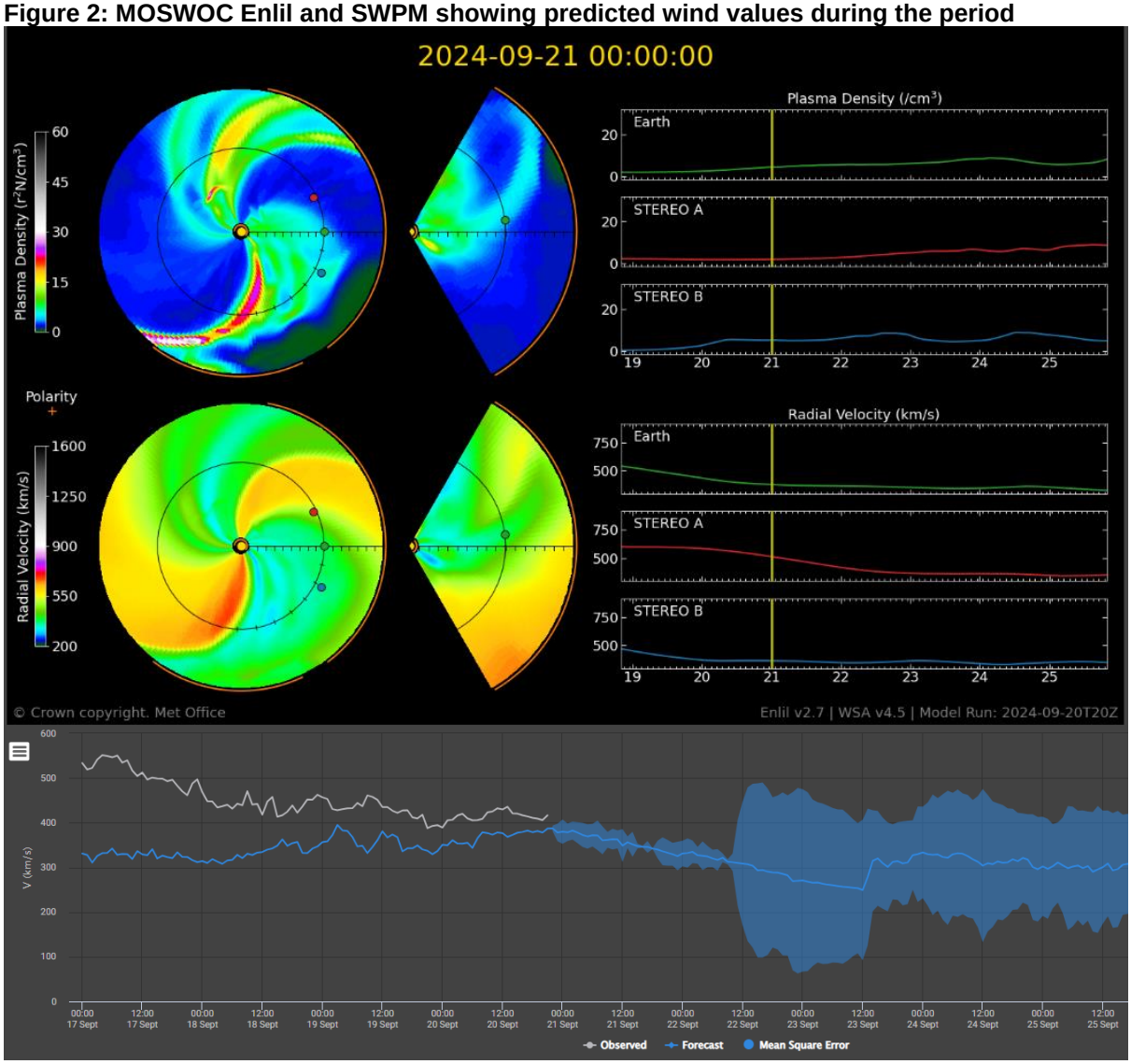
Figure 2: MOSWOC Enlil and SWPM showing predicted wind values during the period



Radio Blackouts - X-Ray Flares:

Low to Moderate activity is expected with a chance of isolated M-class flares maintained throughout.

There are currently seven sunspot regions on the disc, a number of which are of note given their current, or historical, complexity. AR3828 (Dki/Beta-Gamma), in the southeast, is now the largest region on the visible disc and is also one of the most complex. This region consists of a large lead spot surrounded by a fluctuating number of smaller spots of similar or opposite polarity in relatively close proximity. AR3831 (Dsi/Beta-Delta) near central disc in the north rapidly grew on 19 Sep and now contains a faint delta region in its larger lead spot.

AR3825 (Eso/Beta-Gamma-Delta), which produced the X4.5 on 14 Sep, is now a small region near central disc, and although has decreased in size, it retains some complexity, including in the form of a small delta spot in its lead portion. Newly numbered AR3832 (Dso/Beta) in the northwest, emerged during the last 24 hours and continues to exhibit signs of growth.
Ex-AR3824 passed fully beyond the western limb over the past 24 hours but maintains a flare risk during Day 1 (21 Sep).

The other regions currently remain simpler and stable, although newly numbered AR3834

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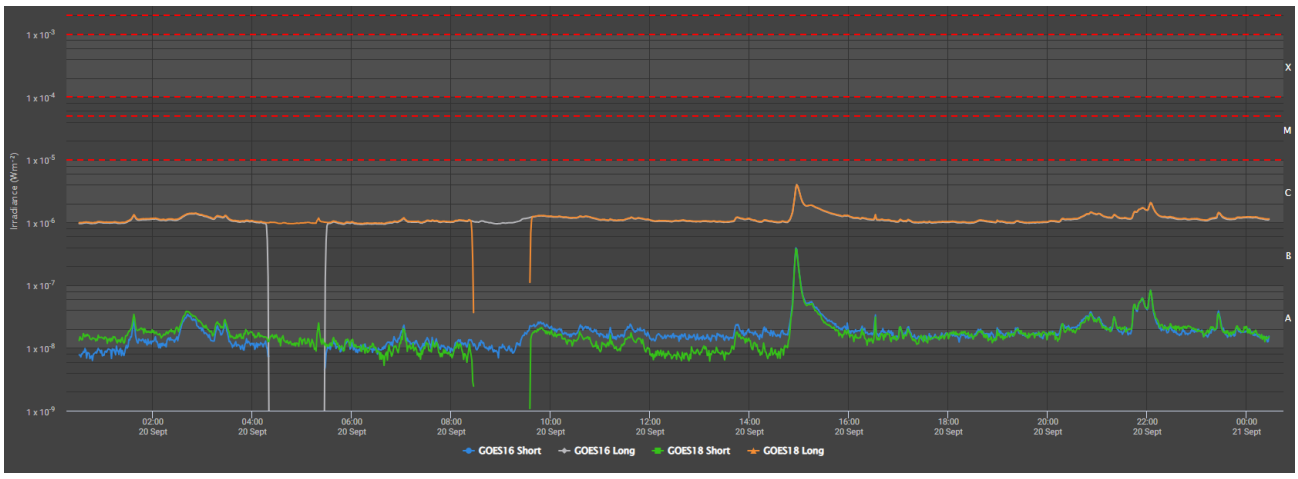
(Hsx/Alpha) close to the southeast limb has the potential to reveal further complexity as it moves into a clearer view.

No regions are expected to rotate off the disc during the period. SDO imagery suggests that something may rotate onto the disc during coming days with far-sided helioseismology supporting the idea of some smaller regions rotating onto the disc during the forecast period. Due to the uncertainty, no contributions from these regions are included in the forecast probabilities.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 M Class**	No	50	50	50	50
Very Active	**R3 to R5 X Class**	No	5	5	5	5

Figure 3: GOES16 and GOES18 X-ray trace



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux at GOES18 is at background levels. AR3825 in the southwest, was previously the source of an X-class flare and cause of the S1/Minor Radiation storm on 17 Sep. However, this region has now simplified, reducing the probability for notable flares from this source during the period.

AR3828 in the southeast has the potential to produce notable flares and will be monitored as it rotates into a more favourable position for producing a response at Earth. As a result, flare probabilities have been maintained at a very slight chance.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy flux, as observed by GOES-16 at GEO has shown an increase through 19 and 20 Sep with rising to High at diurnal maximum between approximately 20/1430-2000 UTC. This is due to the charging of lower orbital levels, from the CME arrival overnight on 16-17 Sep, which, as solar winds have subsequently eased, have expanded outward. With no further notable solar wind enhancements during the period, forecast flux is likely to persist at Moderate to High at GEO, perhaps becoming persistently High from later Day 1 (21 Sep). Confidence does fall later in the period however, due to the potential for any weak solar wind enhancement from the arrival of fast winds from CH71/+ which could potentially cause a drop out in observed flux later on Day 2-3 (22-23 Sep).

The associated 24 hour fluence is expected to continue its rising trend, likely rising to around, or just above the Active level (1e8 total pfu) later Day 1 or into Day 2 (21-22 Sep). This rising trend is indicated by REFM, but is currently considered underestimated. The confidence falls later in the period due to uncertainty in any HSS influence.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	60	60	40	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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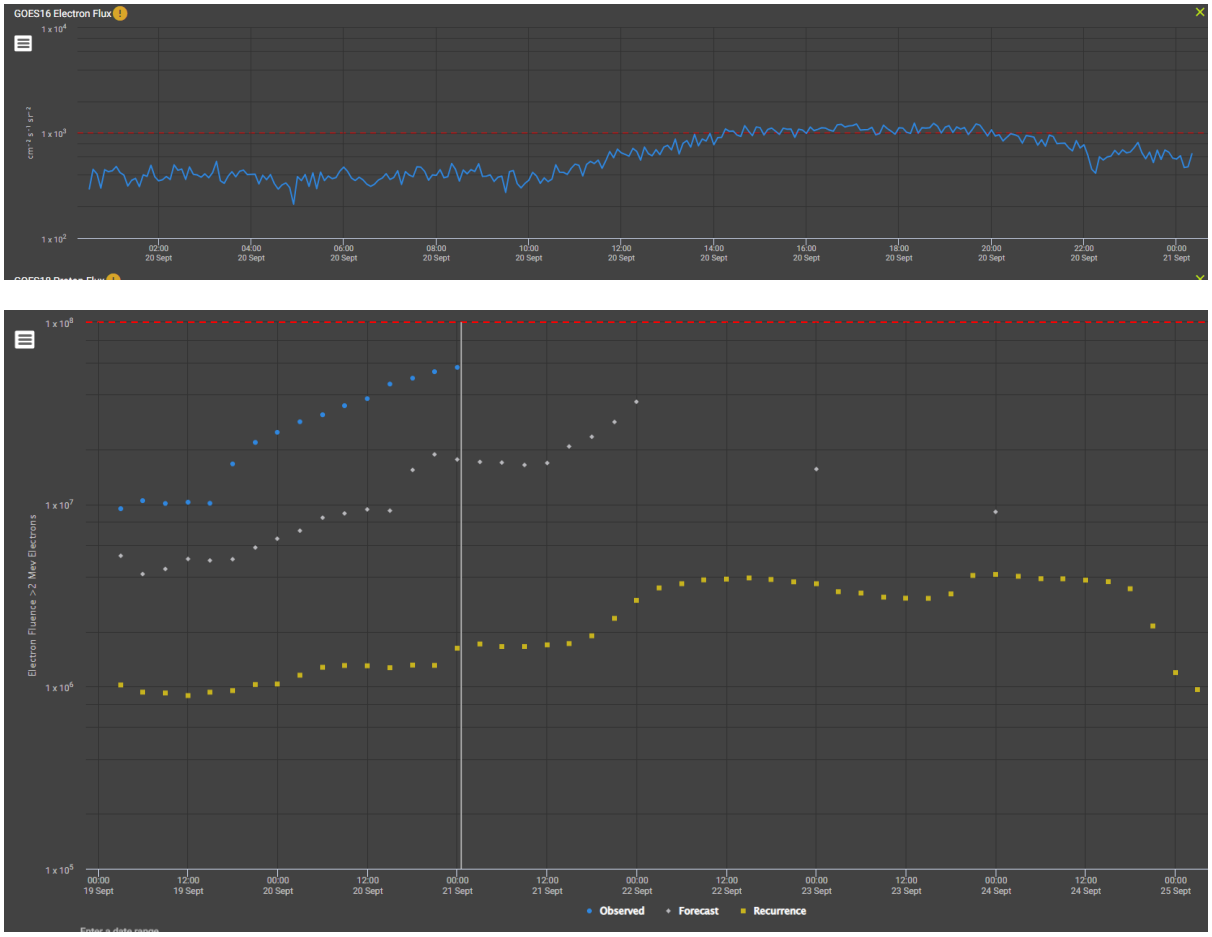
Figure 4: GOES16 Electron Flux and MOSWOC REFM showing rising trend in flux and observed fluence values.



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